## Collaboration and innovation between heterogeneous actors

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# General discussion

## DISCUSSING COLLABORATION AND HETEROGENEOUS ACTORS

This dissertation begins by stating that in our fast-changing world with increasing connectedness between products and services organizations face complex problems (George, Howard-Grenville, Joshi, & Tihanyi, 2016). To solve these problems, organizations need to collaborate and innovate with actors that have different backgrounds and interests (Fjeldstad, Snow, Miles, & Lettl, 2012; Gulati, Puranam, & Tushman, 2012a). The escalation of digital infrastructures and platforms in the 21st century readily enable such collaboration and innovation between heterogeneous actors (Constantinides, Henfridsson, & Parker, 2018; Tilson, Lyytinen, & Sørensen, 2010; Yoo, Henfridsson, & Lyytinen, 2010). I argue that, particularly in such collaborations, the diversity of backgrounds, understandings, perspectives and interests – such as, science and business or public and private organizations – bring to the fore contradictions where actors have strong opposing preferences. Since these collaborations are different from the more homogeneous collaborations studied in extant literature, prior research suggestions regarding how actors should deal with contradictions are sometimes counterintuitive and at large do not explain how organizations organize and manage the contradictions they encounter.

Informed by contradictions literature (De Rond & Bouchikhi, 2004; Farjoun, 2016; Hargrave & Van de Ven, 2017; Lewis, 2000; Putnam, Fairhurst, & Banghart, 2016; Smith & Lewis, 2011), I took on the view that contradictions are neither good nor bad, and set out to answer the following research question: *How do collaborations between multiple organizational actors with heterogeneous backgrounds and interests organize and manage the contradictions they encounter?* In doing so, in three papers my co-authors and I looked into three contradictions: (1) open versus closed innovation, (2) centralized versus decentralized control, and (3) collaborative versus conflicting goals. As such, Chapters 2, 3, and 4 each provide an answer to the research question by focusing on one of the contradictions. In addition, there are also connections between the contradictions and our findings on how collaborations among heterogeneous actors organize and manage them.

The structure of the rest of this chapter is as follows. First, I summarize the key findings of Chapters 2, 3, and 4 and link these to the three contradictions central to this study, along with building on extant contradictions literature to discuss how collaborations of heterogeneous actors are organizing and managing contradictions. As a result, each chapter provides an answer to the main research question of the dissertation. Second, for each chapter, I discuss the implications to

the literature in each paper, the contradictions literature, and the broader research stream on collaborations between heterogeneous actors. Per chapter I also provide suggestions for future research. Third, I discuss relevant practical implications based on the chapters in this dissertation, again relating to the three contradictions central to collaborations between heterogeneous actors. Finally, Chapter 5 ends with a personal reflection on studying collaborations between heterogeneous actors. Table 1 provides a comprehensive overview of the main findings, answers to the dissertation research question, theoretical implications, future research suggestions, and practical implications.

## SUMMARY OF KEY FINDINGS

In this part I provide a summary of the key findings of Chapters 2, 3, and 4 in three subsections that relate to one of three contradictions. Each sub-section thereby includes an answer to the overarching research question of this dissertation.

### Contradiction 1: Open versus closed innovation

In Chapter 2 we reported on a systematic literature review of 1,017 open innovation articles and found evidence for our argument that open innovation is not a unidimensional construct but includes two distinct dimensions: (1) openness of knowledge flows and (2) openness of system architectures. From this, we determined four models of open innovation and for each reported settings, value creation mechanisms, and value appropriation mechanisms.

Utilizing a process perspective, our systematic analysis revealed that open innovation is not a static but a dynamic construct where organizations are both opening and closing knowledge flows and system architectures over time. We conclude that these opening and closing dynamics are influenced by value creation and value appropriation opportunities. Moreover, value creation and value appropriation opportunities connect the two openness dimensions in interesting ways.

**TABLE 1**
**Summary outcomes of Chapters 2, 3, and 4**

| Chapter | Main findings | Answer to research question | Theoretical implications | Future research | Practical implications |
|---|---|---|---|---|---|
| 2. Research question: How do open knowledge flows and open system architectures interact and affect the processes and outcomes of open innovation? | – Open innovation is a two-dimensional construct of open knowledge flows and open system architectures<br>– Open innovation is a process construct with opening and closing dynamics on different levels of analysis<br>– Opening one dimension triggers value creation from opening the other dimension<br>– Opening one dimension triggers value appropriation from closing the other dimension | – Opening and closing dynamics reveal temporally separation strategy<br>– Spatial separation allows organizations in collaborations of heterogeneous actors to deal with the contradiction by pursuing open and closed innovation at the same time<br>– Combining temporal and spatial separation enables open and closed innovation to become mutually enabling | – Open innovation is a two-dimensional and dynamic construct<br>– Open innovation happens without knowledge flows across boundaries<br>– Open innovation includes (interconnected) opening and closing dynamics influenced by value creation and appropriation opportunities<br>– Combining open and closed innovation requires temporal and spatial separation<br>– Unpacking contradictions of multiple types of dimensions adds to understanding how to organize and manage them<br>– Contradictions play out differently on various levels of analysis arguing for a dialectical perspective of open innovation | – Longitudinal process studies on open innovation, especially in digital settings<br>– Study open system architectures linking to platform studies<br>– Further develop dynamic open innovation building on contradictions literature<br>– Further studying collaboration and innovation in settings with open knowledge flows and system architectures | – Open your system architectures<br>– Timing is key in opening and closing innovation |
| 3. Research question: How does a distributed collaboration of organizations with heterogeneous backgrounds and interests develop an infrastructure of common resources? | – Common resources develop through iterative forking and merging of options and micro-alliances<br>– Micro-alliances enable finding agreement without involving all actors<br>– Alternating between forking and merging accommodates differences and dependencies between heterogeneous actors<br>– Interdependencies explain emergence consensus and dissensus | – Alternating between forking and merging is a temporal separation strategy to organize and manage the centralized versus decentralized control contradiction<br>– Forking of options and micro-alliances is a spatial separation strategy to organize and manage the centralized versus decentralized control contradiction | – Micro-alliances accommodate the differences and dependencies between heterogeneous actors when boundary objects are developing<br>– Micro-alliances reflect the heterogeneity inside seemingly single-minder collaborations<br>– Micro-alliances explain organizing in settings where hierarchy is not feasible<br>– Divergence in collaborations is not necessarily an indication of failure to cooperate<br>– Interdependencies between technical and organizational resources explain progress through dissensus<br>– Micro-level confirmation and partial falsification of mirroring hypothesis | – Further study the development process of common resources and applicability of micro-alliances in complex and extreme settings<br>– Study material influences of options in development digital infrastructures<br>– A study of options and micro-alliances using social network analysis techniques building on actor network theory | – Develop technical and organizational common resources<br>– Do not formalize but let micro-alliances emerge |
| 4. Research question: How do organizations with heterogeneous backgrounds and interests realize sustained collaboration on a broad goal despite the emergence of conflicting sub-goals? | – Conceptualizing future-oriented sub-goals postpones conflict<br>– Contextualizing present-oriented sub-goals postpones and resolves conflict<br>– Conceptualizing and contextualizing lead to acceptance of conflicting sub-goals and sustained collaboration on broad goals<br>– Conceptualizing and contextualizing dynamic can lead to adoption of a collaborative-conflict frame | – Collaborations between heterogeneous actors organize and manage the collaborative versus conflicting goals contradiction through acceptance and synthesis<br>– Acceptance and synthesis make collaborative and conflicting goals become mutually enabling<br>– Interdependencies between contradictions enable different organizing and managing strategies | – Through conceptualizing and contextualizing broad collaborative and conflicting sub-goals become mutually enabling realizing sustained collaboration<br>– In collaborations between heterogeneous actors postponing and indecision are not bad but part of the process of realizing broad goals and making progress<br>– Acceptance leading to mutually enabling collaborative and conflicting goals triggering synthesis in a collaborative-conflict frame suggests linkages between dialectics and paradox research | – Study conceptualizing and contextualizing in politically-laden settings<br>– Further study the dialectics of collaboration and conflict<br>– Study conceptualizing and contextualizing as social mechanisms for managing economic and mathematical paradoxes<br>– Study postponing and indecision as a resource for collaboration<br>– Develop dictionaries to measure collaboration and conflict in texts | – Discuss goals taking account of time, concepts, and context<br>– Postponing can be part of realizing broad collaborative goals |

Our analysis revealed that opening one dimension typically increases value creation opportunities from openness on the other dimension. For example, opening knowledge flows with external platform developers adds to the value that can be created from open system architectures (Ghazawneh & Henfridsson, 2013). We found the opposite to be true for value appropriation, where opening on one dimension triggers closing on the other. For example, opening knowledge flows with external developers on a platform also triggers organizations towards closing system architectures in order to capture value from innovations (Garud, Jain, & Kumaraswamy, 2002). Lastly, we found the opening and closing dynamics to be related to the level of analysis. For example, prior research using an organizational level of analysis typically reported increasingly open knowledge flows (Dittrich & Duysters, 2007; Dodgson, Gann, & Salter, 2006; Love, Roper, & Vahter, 2013), whereas studies on a project level reported closing of knowledge flows over time (Bosch-Sijtsema & Bosch, 2015; Oxley & Sampson, 2004; Zobel, Balsmeier, & Chesbrough, 2016).

The findings in Chapter 2 provide an answer to the research question of this dissertation. We find that organizations in collaborations between heterogeneous actors adjust between opening and closing innovation over time in order to benefit from value creation and value appropriation opportunities. This opening and closing mimics sequential or oscillating patterns described in ambidexterity literature (O'Reilly & Tushman, 2013), and the temporal separation strategy for managing contradictions (Poole & Van de Ven, 1989). Furthermore, by reconceptualizing and open innovation as a two-dimensional construct we showed that organizations can deal with contradictions through spatial separation (Lewis, 2000; Poole & Van de Ven, 1989; Smith & Lewis, 2011); in this case by being able to perform opening or closing on different types of open innovation (see Table 2). Taking these two insights together, the findings in Chapter 2 also argue that organizing and managing contradictions in collaborations among heterogeneous actors is about combining temporal and spatial separation strategies (see Table 2). Temporal separation allows organizations to benefit from opening and closing innovation dynamics, whereas spatial separation allows this to happen on two separate dimensions which dampens the downsides of temporally separating one pole over the other. As a result, open and closed innovation become mutually enabling (see Table 2).

**TABLE 2**
**Contradictions in collaborations between heterogeneous actors**

| Chapter | Contradiction in extant literature | | Our findings on contradiction | | Our findings on organizing and managing contradiction |
|---|---|---|---|---|---|
| 2 | Open innovation | Closed innovation | Open knowledge flows | Closed knowledge flows | – Temporal separation<br>– Spatial separation<br>– Combining temporal and spatial separation<br>– Mutually enabling |
| | | | Open system architectures | Closed system architectures | |
| 3 | Centralized control | Decentralized control | Centralized control | Decentralized control | – Temporal separation<br>– Spatial separation |
| 4 | Collaborative goals | Conflicting goals | Collaborative-conflict frame | | – Mutually enabling<br>– Acceptance<br>– Synthesis<br>– Acceptance leads to synthesis |
| | | | Collaborative goals | Conflicting goals | |

**Contradiction 2: Centralized versus decentralized control**

In Chapter 3 we reported on a longitudinal case study of Helix Nebula. We studied how the organizations in Helix Nebula collaboratively developed an infrastructure of technical and organizational common resources. We find that the development of common resources is not contained in a single, homogeneous trajectory. Rather, it contains an iterative forking (i.e. breaking up) and merging (i.e. getting back together) of development trajectories, in which different options are explored by micro-alliances. Micro-alliances are sub-groups of organizations that flexibly emerge around options and are comprised of two types of actors: decision-making actors and endorsing actors. Decision-making actors are actively involved in developing options, whereas endorsing actors are in the background giving support. This structure of micro-alliances allows for finding agreement without having to involve all actors. We find that alternating between forking and merging of options and micro-alliances is important to the development of common resources because this accommodates both the differences and dependencies among the heterogeneous actors. We also find that forking and merging of options happens consensually and non-consensually. In fact, to keep alternating between forking and merging, dissensus can be inevitable. We find that interdependencies between common resources stimulate the emergence of dissensus in technical resources, consensus in organizational resources, and make that consensus in organizational resources accommodates dissensus in technical resources.

The findings of Chapter 3 address the research question of this dissertation by showing how forking and merging of options and micro-alliances provide a solution to the contradiction of centralized and decentralized control. The flexible and iterative forking and merging of options and micro-alliances make that development accommodates the differences between actors through forking (i.e. providing the benefits of decentralized control) and their dependencies through merging (i.e. providing the benefits of centralized control). Alternating between forking and merging resembles the temporal separation strategy for managing contradictions (Poole & Van de Ven, 1989). Forking of options and micro-alliances also resembles the spatial separation strategy for dealing with contradictions (Lewis, 2000; Poole & Van de Ven, 1989; Smith & Lewis, 2011). By splitting development into different trajectories, the collaborating organizations realize the benefits of centralized control in the multiple decentralized micro-alliances that develop different options.



**Contradiction 3: Collaborative versus conflicting goals**

In Chapter 4 we studied the collaborative versus conflicting goals contradiction using our longitudinal data on collaboration in Helix Nebula. In line with prior research findings, we find that collaborative goals enable the development of conflicting goals in collaborations of heterogeneous actors. Extending this insight, we find that conceptualizing and contextualizing are mechanisms that enable actors to accept and perceive their conflicting sub-goals as part of realizing broad collaborative goals. As a result of this acceptance that collaborative goals and conflicting goals are interdependent, sustained collaboration on broad collaborative goals is realized. The process model in Chapter 4 shows how the dynamic of conceptualizing and contextualizing leads to the adoption of a collaborative-conflict frame in a collaboration of heterogeneous actors. In this frame collaborative and conflicting goals are not just accepted but become integrated, where conflict is no longer opposing but perceived to be part of collaboration.

The findings in Chapter 4 show how, contrary to common assumption in extant collaboration literature, collaborative and conflicting goals can become mutually enabling instead of contradictory forces (see Table 2). Echoing prior research (Grodal & O'Mahony, 2017), we show how collaborative goals enable the emergence and surfacing of conflicting goals in collaborations between heterogeneous actors. Yet, we find that this also happens the other way around where conflicting goals enable sustained collaboration on collaborative goals. Our process model of how this happens includes elements of both the acceptance and synthesis strategies (Lewis, 2000; Poole & Van de Ven, 1989; Smith & Lewis, 2011) for organizing and managing contradictions (see Table 2). Conceptualizing and contextualizing leads to the acceptance that collaborative goals include pursuing underlying conflicting goals. Over time, acceptance can lead to synthesis when the collaboration of heterogeneous actors adopts a collaborative-conflict frame where conflicting goals are perceived to be part of the process of realizing collaborative goals.

The acceptance and synthesis strategies analyzed in Chapter 4 complement the findings on the effect of interdependencies on the emergence of consensus and dissensus in the development of common resources in Chapter 3. As long as the heterogeneous actors see conflict as a necessary part of collaboration, it is possible to make progress through periods of recurring dissensus.

## THEORETICAL IMPLICATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

In the next section the theoretical implications and suggestions for future research are discussed for each of the contradictions in turn (see Table 1 for an overview). In doing so, these are tuned to the literature central in each chapter as well as to the research on contradictions and collaborations between heterogeneous actors. Per contradiction I provide suggestions for future research (see Table 1 for a summary).

### Implications contradiction 1: Open versus closed innovation

The central contribution of Chapter 2 is that we further develop open innovation from a unidimensional construct focused on open knowledge flows (Chesbrough, 2003; Dahlander & Gann, 2010; Laursen & Salter, 2004, 2006; Van Burg, Berends, & Van Raaij, 2014; Van den Ende, Frederiksen, & Prencipe, 2015) into a two-dimensional construct that also includes open system architectures (Baldwin & Von Hippel, 2011; Ghazawneh & Henfridsson, 2013; Langlois & Robertson, 1992). In effect, we argue that extant literature shows that open innovation also happens without knowledge flows across organizational boundaries.

Our study contributes a dynamic perspective to open innovation, integrating opening and closing dynamics reported by extant open innovation literature. Overall, our dynamic perspective argues that open innovation is not a unidirectional process towards more openness but includes opening and closing of innovation processes. We thereby echo the finding of Van Burg et al. (2014) who also recognized that in collaborations actors may change the degree of knowledge sharing over time. The opening and closing dynamics enable organizations to benefit from value creation and value appropriation opportunities from both open and closed innovation. This notion extends discussions in prior research on the combinatory value of open and closed innovation processes (Faems, De Visser, Andries, & Van Looy, 2010). However, understanding how organizations can be open and closed at the same time is challenging without utilizing a dynamic process perspective. We did utilize that process perspective in our study. We show that combining open and closed innovation requires a combination of temporal separation (e.g. first opening then closing) and spatial differentiation between open innovation through knowledge flows and system architectures (e.g. open knowledge flows but closed system architectures).

The findings of Chapter 2 also have implications for contradictions literature; as we showed that contradictions can involve two-dimensional constructs, in our case knowledge flows and system architectures underlying the open versus closed innovation contradiction. In a similar vein, Farjoun (2010) argued for a two-dimensional view differentiating between mechanisms and outcomes of a contradiction. We extend this processual take by showing how unpacking a contradiction of multiple types of dimensions (e.g. knowledge flows and system architectures) adds to the understanding of organizing and managing strategies.

Our literature review of extant open innovation literature also revealed how the level of analysis is influential for whether opening or closing dynamics are visible. For example, on a platform level of analysis, studies reported an opening of system architectures over time, whereas studies on a component level reported both opening and closing. This finding that contradictions play out differently on various levels of analysis echoes insights from the dialectic perspective (Benson, 1977; Zeitz, 1980), which may add an additional frame to study open innovation next to paradox (Dragsdahl Lauritzen & Karafyllia, 2018).

*Future research*

The findings in Chapter 2 on the open versus closed innovation contradiction in collaborations of heterogeneous actors suggests several avenues for future research. First, future open innovation research should focus on doing longitudinal process studies (Langley, 1999). Especially in more digitally-mediated settings studying longitudinal dynamics of opening and closing is feasible given changes can be tracked through digital traces (Kallinikos, Aaltonen, & Marton, 2013). Second, we encourage open innovation scholars to connect to platform research and study open innovation through system architectures. Third, future research should push towards making open innovation a dynamic and two-dimensional construct. To ease this transition scholars can build on the insights from contradictions literature (Putnam et al., 2016), which provides several perspectives (e.g. dualism and duality) that can serve different types of open innovation research including further work on open innovation as paradox (Dragsdahl Lauritzen & Karafyllia, 2018). Fourth, our study shows that collaborative innovation is challenging especially in settings having open knowledge flows and open system architectures. We used this as an argument for studying contradictions as well as for collaborations between heterogeneous actors, and encourage future research to extend this further.

**Implications contradiction 2: Centralized versus decentralized control**

Chapter 3 contributes to literature on interorganizational collaboration (Gulati, Wohlgezogen, & Zhelyazkov, 2012b; Majchrzak, Jarvenpaa, & Bagherzadeh, 2015), in particular to the emergent stream of research on distributed collaborations (Beck & Plowman, 2014; Gulati et al., 2012a; Tuertscher, Garud, & Kumaraswamy, 2014) between heterogeneous actors (Fjeldstad et al., 2012; Majchrzak, Griffith, Reetz, & Alexy, 2018), and has implications for research on digital infrastructures and platforms (Constantinides & Barrett, 2015; Constantinides et al., 2018).

The first contribution of our study is that we introduce the concept of micro-alliances to interorganizational collaboration literature. We show that a seemingly integrated interorganizational collaboration can involve multiple embedded micro-alliances that consist of organizations with heterogeneous understandings, perspectives, and interests. Micro-alliances have the fluidity to emerge and dissolve where necessary, and thereby can split up and unite actors where possible. The distinction between decision-making and endorsing actors contributes to the flexibility of micro-alliances. Because of this dual structure, micro-alliances are a vehicle for finding agreement among a group of heterogeneous actors without having to involve all of them in discussions.

Our study contributes an understanding of emergent organizing to interorganizational collaboration literature (Fjeldstad et al., 2012; Majchrzak et al., 2018). Micro-alliances explain how collaboration happens when there are no established technical or organizational resources that can be used for coordination and cooperation. We show that when boundary resources are absent or being developed (Carlile, 2002, 2004), organizations work together in sub-groups that flexibly emerge and dissolve in order to accommodate differences and dependencies between actors. This also contributes to our understanding of organizational design decisions in the formation stage of meta-organizations (Ahrne & Brunsson, 2005) and interorganizational collaborations (Gulati et al. 2012b). Because micro-alliances cannot be designed but emerge naturally, they are able to reflect the differences and dependencies between organizations on decisions such as membership boundaries of meta-organizations (Gulati et al. 2012a) or legal structures of alliances (Gulati & Singh, 1998). Micro-alliances also contribute to the emergent interest in polycentric governance in interorganizational collaboration (Sydow & Windeler, 1998) and digital infrastructures literature (Constantinides & Barrett, 2015; Constantinides et al., 2018), by adding the notion of process, calling for future research on polycentric governing.



Second, prior research has taken the existence of resources that facilitate collaboration for granted (Fjeldstad et al., 2012; Gulati et al., 2012a; Majchrzak et al., 2018; O'Mahony & Bechky, 2008; Tuertscher et al., 2014) or assumed a centralized actor as driver of the development (Garud et al., 2002; Rosenkopf, Metiu, & George, 2001). We show that common resources emerge in an iterative process of forking and merging options that are developed by organizations collaborating in micro-alliances. This contributes to interorganizational collaboration research by suggesting that divergence between organizations in a collaboration, including opportunistic self-serving behavior, is not necessarily an indication of failure to cooperate. Rather, splitting up the collaboration can be a temporary solution that enables progress in a later stage. This is in line with earlier findings on the value of a dialectical understanding of interorganizational collaboration (Berends, Van Burg, & Van Raaij, 2011; Das & Teng, 2000; De Rond & Bouchikhi, 2004).

What our study also shows is that developing multiple common resources at the same time is important to make progress. The emergent resources can then build on each other's progress thereby leveraging interdependencies between them. For example, when the development of a common technical interface gets stuck during forking, progress in another interdependent organizational resource, for example membership guidelines, can support merging. This contributes to interorganizational collaboration and digital infrastructure literature on the importance of considering interdependencies between technical and organizational resources (Brusoni & Prencipe, 2006; Wareham, Fox, Cano Giner, 2014).

Third, we conclude that both consensus and dissensus are needed in interorganizational collaboration. This aligns with the insight by Hardy and Phillips (1998) that contestation and collaboration can both be sources of synergy and engagement in interorganizational collaborations. Furthermore, our findings resonate with earlier research that showed that not all interorganizational problems can be resolved in consensus (Gray & Hay, 1986) due to heterogeneous understandings, perspectives, and interests of actors, which makes dissensus inevitable. This also offers a micro-level confirmation and partial falsification of the mirroring hypothesis that an organizational structure tends to correspond (i.e. mirror) to the design of a technical system (Henderson & Clark, 1990; Sanchez & Mahoney, 1996). However, we find that sometimes collaborating actors make valuable progress in dissensus when the reconfiguration of options and micro-alliances is misaligned (i.e. not mirroring). Hence, our analysis shows that micro-level collaborative developments tend to follow the dynamics of a mirroring technical and organizational design but

that this includes inevitable dissensus. Lastly, our findings contribute the importance of studying the interdependencies between technical and organizational resources in interorganizational collaboration. We find that often consensus in organizational resources supports dissensus in interdependent technical resources. Such effects need to be accounted for when assessing the conditions in which heterogeneous organizations are most likely to realize consensus (Ranganathan, Ghosh, & Rosenkopf, 2018).

*Future research*

The findings in Chapter 3 encourage future research to study the development of different types of common resources, for example, design rules (Baldwin & Clark, 2000), in collaborations between heterogeneous actors to see if the elements of our process model hold. Especially, future research should look at the role micro-alliances play in complex or even extreme settings, such as the development of common norms and values in settings where collaborators are anonymous (Dobusch & Schoeneborn, 2015) or in settings where actors are at war (De Rond & Lok, 2016). In contrast, it would also be interesting to study how long-established common resources get disrupted or complemented. For example, how do changes come about in the rules of chess, or how do complementary common resources like chess computers that aid players become introduced, which would require longitudinal process data (Langley, 1999), and potentially action-based research, on chess players as well as the World Chess Federation.

Our study shows the potential of future research on actor network theory in the development of digital infrastructures. In our research we did not delve deeply into the material power of common resource options and future research can look at how, for example, technological limitations influence development of common resources. This is especially interesting when studying the development of digital infrastructures because one of the key elements of digital innovation is the unbounded potential for recombination of material elements (Henfridsson, Nandhakumar, Scarbrough, & Panourgias, 2018; Yoo et al., 2010).

Future research is also encouraged to explore the potential of using social network analysis techniques to study material options and social micro-alliances as distinct types of nodes. In such an analysis it is possible to study the role of material power in developing dominant options and micro-alliances. Furthermore, it is possible to integrate a dialectics perspective in such analysis and develop a theory of potential options. Our study showed how often a slightly altered option competed with the focal option from which it emerged. Using social network analysis combined with simulation techniques, the development of potential options can be studied.

**Implications contradiction 3: Collaborative versus conflicting goals**

An important contribution of Chapter 4 is that we shed light on how complex multi-actor collaborations can be sustained over time without displacement of the broad goal that motivated them (Grodal & O'Mahony, 2017). Our findings show that to realize sustained collaboration requires conceptualizing and contextualizing of a broad goal and underlying disparate sub-goals. These two mechanisms allow heterogeneous actors to postpone and resolve conflict between sub-goals and eventually accept that pursuing conflicting sub-goals is necessary and part of realizing their broad collaborative goal.

We contribute to interorganizational collaboration literature by offering a novel perspective on the conflict versus collaboration duality (De Rond & Bouchikhi, 2004; Hardy & Phillips, 1998). Prior research has argued that conflict can be both good and bad for collaborations (Lumineau, & Oliveira, 2018). Our contribution is that conflict is neither good nor bad but unavoidable and necessary for collaboratively realizing a broad goal. We show that what matters is how actors perceive their conflicting sub-goals to be related to realizing the broad goal. Another contribution of our study is that we show that postponing and indecision are not necessarily negative for realizing collaborative outcomes (Denis, Dompierre, & Langley, 2011), but in collaborations among heterogeneous actors are part of the process of realizing collaborative goals.

Chapter 4 also contributes to contradictions literature by showing linkages between the processual dynamics of the dialectic perspective and the resolving focus of paradox research. In line with dialectics research we showed that collaborative and conflicting goals are mutually enabling. Over time, the mutual enablement of collaborative and conflicting goals triggers acceptance through sustained collaboration and synthesis in a collaborative-conflict frame. We thus echo conceptual suggestions by Hargrave & Van de Ven (2017) that in contradictions, dialectical conditions such as conflict and mutual enablement are a generative force for paradox-informed solutions.

*Future research*

Our findings on how collaborations between heterogeneous actors organize and manage the collaborative versus conflicting goals contradiction promote various avenues for future research. I encourage future research to study conceptualizing and contextualizing in different settings where there is interest in collaboration between actors with heterogeneous backgrounds. Particularly, it would be interesting to study how conceptualizing and contextualizing happens in politically-laden settings such as the European Union. Closer to home, the arena of management research provides fertile ground in which we are currently enjoying the start of a period of research on artificial intelligence where different research streams seek dominance. Given that conferences provide a platform for establishing field domains (Garud, 2008), longitudinal data collection can start now by scraping textual data from conference websites, such as paper abstracts, full papers, and presentations.

Future research is encouraged to delve into the dialectics of collaboration and conflict. Prior research has often taken a one-sided view, valuing collaboration over conflict. Echoing De Rond and Bouchikhi (2004), such a functionalist perspective may not do justice to the value of conflict for collaboration. Our study is a first attempt at showing how conflict can become accepted as a part of collaboration, and future research on collaborations between heterogeneous actors is encouraged to explore other mechanisms that enable conflict to become assimilated into collaboration. Such research extends into economics and mathematics research, by studying how a conflict in game theory (i.e. a losing strategy) can actually be a sub-game part of a collaboration strategy in another game. As such, future research can elaborate and study conceptualizing and contextualizing as social mechanisms for managing Parrondo's paradox (Harmer & Abbott, 1999), known as a situation where a combination of losing strategies becomes a winning strategy.

Our research shows that postponing need not necessarily be of negative influence to realizing collaborative goals in collaborations between heterogeneous actors. Future research is encouraged to further study postponing and indecision as a resource for collaboration and discover other settings where these counterintuitive dynamics hold. An interesting study could be done looking at the role of software beta-versions as an object that materialized postponing strategies and the opportunities they bring for catalyzing collaborative conflict.

One of the limitations we encountered in using digital methods for qualitative data was the limited potential for analyzing collaboration and conflict in texts. We encourage future interdisciplinary research among management scholars, computer scientists, and language scholars for developing and validating dictionaries to measure collaboration and conflict in texts.



## PRACTICAL IMPLICATIONS

In June 2018, Bain & Company (2018) in collaboration with the World Economic Forum published a Digital Transformation Roadmap in which collaboration and innovation between heterogeneous actors is reported as an important enabler of digital transformation. Furthermore, the report acknowledges the critical role of digital infrastructures and platforms as catalyzers of collaboration. Although firms and organizations may have years of valuable experience in collaboration with external actors with similar backgrounds and overlapping interests, digitalization promotes collaboration with actors that have heterogeneous backgrounds and interests. The findings of this dissertation provide relevant insights for managers preparing their organizations for digital transformation. Broadly, managers need to be aware that collaboration between heterogeneous actors as part of digital transformation will inevitably present contradictory demands and preferences. Next, I describe some practical handles and tools that enable managers to deal with some of these contradictions, including: (1) open versus closed innovation, (2) centralized versus decentralized control, and (3) collaborative versus conflicting goals.

### Contradiction 1: Open versus closed innovation

Most firms have gained abundant experience with open innovation in the past two decades as regards to sharing knowledge with external collaborators. Digital transformation requires extending this experience by opening system architectures and dynamic strategies for opening and closing. Managers are therefore advised:

– *Open your system architectures*

In order to prepare for digital transformation organizations should think not just about sharing knowledge with external actors. To ride the current digitalization wave and establish an effective digital transformation strategy, open system architectures are a necessary requirement. Using open systems, for example in a platform-based strategy, enables firms to create value in collaboration with a wide range of heterogeneous actors, including competitors, scientists, universities, and governments. Nonetheless the challenge that inevitably will face managers is: How open should

system architectures become? To start with, managers should evaluate how to integrate interfaces into current and new products that enable external actors to develop complementary products and services. In doing so, managers can start by opening up to selective target groups and become more experienced with this new means of value creation. It is important that managers make sure that interfaces can also be closed again over time if necessary, for example, when there is need to take ownership over core elements or capture value from overt and highly innovative complementary innovations.

– *Timing is key in opening and closing innovation*

Our research shows that successful open innovation is not only about timing openness; timing when to close down can be just as important. In recent years Apple has shown how choosing when to close down open innovation is an important source of profit. For example, when closing down the iPhone system architecture through removing compatibility with the 3mm-audiojack increased Apple's profits from complementary innovations like Apple AirPods. Moreover, it gave Apple back the control over value creation in its system architecture, for example by making selfie sticks using the 3mm-audiojack as an input interface incompatible.

**Contradiction 2: Centralized versus decentralized control**

In collaborating with heterogeneous actors in the digital era, new dynamics of control are established. Traditional centralized control strategies from contracts and legal partnerships are not flexible enough to support digital transformation. Rather, managers should try to realize some of the benefits of centralized control while relying on decentralized control in the development of digital infrastructures and platforms. Managers are advised to:

– *Develop technical and organizational common resources*

Our research shows the value of developing common resources like common technical interfaces and common governance models to enable collaboration and catalyze digital transformation among firms. Developing common resources allows organizations to explore overlapping interests without creating immediate lock-in or suffering from free-riding or opportunistic behavior. An analogy to see the value of common resources is to look at sports like tennis, football, or golf, where players accept and do not flexibly change the rules of how to score points, change the outlay of the pitch, or introduce a different type of ball. These common resources do not hamper but catalyze innovation, for example between team's tactics. Similarly, in Formula 1, all teams agree to use the same tires, which is a common resource that enables fairer and more exciting competition between the teams on engine and chassis performance. For companies looking to collaborate as part of their digital transformation strategies, Chapter 3 has shown the relevance of developing both technical (i.e. the rules of the game) as well as organizational common resources (i.e. the rules to change the rules of the game) because it allows organizations to make progress both in consensus and dissensus.

– *Do not formalize but let micro-alliances emerge*

Managers that participate as representatives of their organizations in large-scale collaborations know that often such initiatives are too formalized. Especially in publicly-funded initiatives, who can take what share of the funding-pie is decided upon before collaboration has started; ultimately compromising creativity and innovation. Our research shows that an alternative is to let structure emerge over time, which will lead actors to develop common resource options by working together in micro-alliances. In micro-alliances, the role of less dominant organizations is more important because powerful actors need their support to move options forward. Thus, the European Commission is encouraged to experiment with enabling micro-alliances by developing projects that provide funding on the basis of broad goals, allocation of funding is not pre-set, and have limited participation constraints.

**Contradiction 3: Collaborative versus conflicting goals**

In large-scale collaborations between multiple organizations from different backgrounds and with different interests, collaborative and conflicting goals are a tense subject. For example, all companies want to collaborate as part of digital transformation, but not all companies agree on the specifics of how to do that. In order to ensure that both collaborative goals and the organizations' own (for others conflicting) goals can be realized during digital transformation, managers are advised the following:

– *Discuss goals taking account of time, concepts, and context*

The findings in Chapter 4 show that in large-scale collaborations between heterogeneous actors discussing goals is all about taking account of time, concepts, and context. I encourage managers to use conceptual language when discussing future collaboration and innovation goals with heterogeneous actors. By discussing your own future goals using new popular concepts, vague language, and tentative terms, conflict with the future goals of collaborators is postponed. When discussing present-oriented goals it is important to contextualize goals such that others can perceive how they contribute to collaborative goals. Here managers need to make sure the goals are discussed in specific contexts, relative to other goal contexts, or as part of a broader context.

– *Postponing can be part of realizing broad collaborative goals*

Collaboration between heterogeneous actors as part of an organization's digital transformation process can be slow and tedious. The quick pace of most commercial firms typically clashes with the longer timelines of actors that have different backgrounds and interests, such as science organizations. Managers should be wary of these differences and try to tune the expectations of higher management. Part of this is accepting that postponing of decisions and outcomes is often part of the process of realizing collaborative goals in collaborations between heterogeneous actors, and need not be a sign of dysfunction or lack of momentum.

## REFLECTION ON MY RESEARCH

Studying collaborations of heterogeneous actors is a team effort. It is a team of researchers that reflects, asks questions, and looks at what is interesting and different about collaborations that are large-scale and involve actors with heterogeneous backgrounds and interests. But also, it is a team effort involving those who are being studied. Our team has been fortunate to have been invited so warmly and welcomingly into the Helix Nebula collaboration. In the final section of this chapter I reflect on what I think are some of the things my co-authors and I learned that are important for researching collaborations between heterogeneous actors.

### Getting started

In a setting where there are more than 50 organizations involved, such as Helix Nebula in 2014, getting started with your research, is challenging. Given that by design, these large-scale collaborations are made up of multiple organizations, our experience has been that it works best to be introduced by one of the organizations. Having a contact that supports your objective from the beginning will give the others in the collaboration the confidence that you are up to something good and not there to do damage. In fact, in our case we were fortunate to be given time to make a presentation of our objectives to all organizations in Helix Nebula, which allowed us to show that we were honestly interested in understanding how collaborations between heterogeneous actors organize and manage themselves.

### Friendliness goes a long way

We have found that friendliness goes a long way in researching collaboration and innovation between heterogeneous actors. One thing that researchers should not underestimate is that it is not only them who are in a very challenging and demanding environment but so too are the representatives of the organizations that are being studied. For them the collaboration is about realizing something collaboratively, but they also need to serve their own goals and interests. Like the researcher, they are trying to get data and information on what is happening. This is very different from studying settings that are more bounded like inside a single organization, where representatives feel more at home and comfortable about discussing what they are doing. It can be compared with speaking about your research at a conference or with your close colleagues. The former is typically more frightening, and you hope for friendly responses. Then as you get to know your international colleagues, you become receptive to more critical feedback and find out not everybody looks at reality in the way you or others do. These dynamics hold also true in collaborations between heterogeneous actors.

### Develop evolving relationships

While studying Helix Nebula, our relationships with the various representatives of the different organizations evolved over time, and in each phase new and valuable data could be collected. Developing these relationships took a lot of time and effort from our team, and happened at face-to-face meetings, at airports waiting for delayed planes, over dinner, in conference calls (always enter the call 15 minutes early, there are often people already there in for a chat), via e-mail, and through interviews. One of the most valuable moments of data collection that truly added to Chapter 3 took place two and a half months before finalizing this dissertation, in Amsterdam of all

places (most meetings I attended took place elsewhere in Europe), after a full day of meetings that were observed. In 10 minutes, the representative unprompted, opened up about how, since 2011, certain technical interface options had been developing through the actions and support of different groups of organizations. In a nutshell, the narrative and some detailed examples confirmed our analysis in Chapter 3 about reconfiguring options and micro-alliances. Although one may have wished that the person had voiced that three years earlier, I believe it is more honest to say this was not possible then because we had not developed that trusting relationship.

**Know when to talk and when to keep quiet**

When studying the collaborations of heterogeneous actors one of the most important things is knowing when to talk and when to keep quiet. When I started collecting data in 2014 I applied what I learned from books and tried to be a "fly on the wall". However, the people in Helix Nebula were often interested to hear my opinion and reflection. This was difficult because I did not want my opinion to create an artifact in the data. While I still think that is important to consider, over time I have learned that this does not mean you cannot say anything. In fact, not giving your opinion will be frustrating for them and lead to a lack of trust. I have learned that what is needed is a reflection to make sure your statements do not speak of a preference.

**Tacit knowledge is sometimes more important than explicit data**

Collaborations between heterogeneous actors are often so complex that it can be challenging to even understand what is going on. In Helix Nebula there were not only between 20 and 70 organizations involved over time, all of them had different backgrounds and motivations to collaborate, talked different languages, had different stakeholders, were involved with many different side-projects, and cloud computing was a fast-changing industry. For Chapters 3 and 4 of this dissertation considerable time and effort went into developing a tacit understanding of the larger dynamics of Helix Nebula, which overall enhanced my ability of collecting and analyzing data, writing the findings, and drawing conclusions.

**Be agnostic and hear multiple voices**

In the study on Helix Nebula I quickly realized it was important to be agnostic in order to get a true interface from the representatives of the organizations in Helix Nebula. Because of the heterogeneity of backgrounds in Helix Nebula, I found out that often one person's opinion or statement truly clashed with that of another, mostly between representatives of different organizations. This was sometimes confusing throughout the data collection, because different people provided me with different accounts of reality. Because of these multiple realities, it is important for the researcher to remain agnostic and hear multiple voices without stating a preference. Regarding this, I learned a lot from the paper by Callon (1986). Being agnostic also led me to reflect on the value of conventional management knowledge, which, as discussed next, had to be dropped in order to truly understand collaborations between heterogeneous actors.

**Drop conventional theory and frameworks when necessary**

In the first year of data collection my co-authors and I put a lot of effort into trying to explain why certain events and activities happened in Helix Nebula the way they did. Doing so I created a lot of complex and stylized explanations using prior theoretical frameworks. To be honest, these explanations based on conventional management knowledge did not make much sense and were not representative of the collaborative reality in Helix Nebula. A case in point was that on the basis of conventional management theory, it was difficult to understand why the organizations developed common resources instead of proprietary products and services. Over the course of 2016, when we decided to focus less on trying to fit our case into existing theoretical frameworks, we could suddenly understand the process of collaboration and see why, for example, a lot of common resource options were being created or why organizations kept collaborating despite conflict. When we stopped the urge to hold on to conventional theory and frameworks, we understood more clearly the rationale behind the collaborative dynamics in Helix Nebula.

**Longitudinal data means longitudinal collection**

In our experience longitudinal data collection on collaborations between heterogeneous actors has some peculiarities that are different from other settings. Since there are so many organizations, there are many different takes on when (i.e. the time and date), and the sequence in which, certain events took place. For example, a variation of six months on the perceived start date of Helix Nebula was not uncommon among our interviewees. To avoid mixing up dates, we were very tedious in our data collection efforts and did not store documents and presentations without adding a date to the filename. Furthermore, collaborations among heterogeneous actors are typically long-

enduring efforts that are used by organizations as strategic vehicles, for example, for digital transformation. As such, at the moment of writing, the Helix Nebula collaboration has endured for more than eight years, since 2011 with fluctuating intensities of collaboration, and the next Helix Nebula project has been announced to start in 2019. A longitudinal study on a collaboration between heterogeneous actors like Helix Nebula can require data collection efforts that stretch the average length of a PhD trajectory. As a result of this lengthy duration that collaborations between heterogeneous actors typically have, important events often lay in the past. This highlights the relevance of collecting archival data, which is the point addressed next.

**Find out where collaboration happens**

One of the key elements important in researching collaborations among heterogeneous actors is to find out where collaboration happens. When studying a more bounded setting the locus of collaboration is typically explicit and distinct. It may be a conference room, a separate office, or a factory floor. In a collaboration between heterogeneous actors like Helix Nebula, where there are multiple organizations spread across Europe, there is no single location in which day-to-day collaboration happens. Although there were frequent face-to-face meetings between the representatives of the organizations collaborating in Helix Nebula, we realized that a lot of the collaborative activities happened online through e-mail and in conference calls. Moreover, collaboration happened by means of what was recorded in documents such as meeting minutes, e-mails, and presentations. In our study, the rich archival data on Helix Nebula allowed us a unique insight into the micro-dynamics of collaboration between heterogeneous actors.

**Embrace serendipity**

The final reflection point I want to make is that researchers need to embrace serendipity in studying collaboration and innovation between heterogeneous actors. In my experience, going into the field with a careful plan of how many interviews when, where, and how is simply not going to be of any help in this type of collaborations. I found the immensely detailed Helix Nebula e-mail data more or less by accident, and this serendipitous moment has paid off ever since. The richness of this data cannot be described, but analyzing it sometimes felt like those moments when reading a book you just cannot put down.



**REFERENCES**


Ahrne, G., & Brunsson, N. 2005. Organizations and meta-organizations. ***Scandinavian Journal of Management***, 21(4): 429–449.

Bain & Company. 2018. Digital transformation: A roadmap. Available at https://www.bain.com/insights/digital-transformation-roadmap/. Accessed September 28, 2018.

Baldwin, C. Y., & Clark, K. B. 2000. ***Design rules: The power of modularity (Vol. 1)***. Cambridge, MA: MIT press.

Baldwin, C., & Von Hippel, E. 2011. Modeling a paradigm shift: From producer innovation to user and open collaborative innovation. ***Organization Science***, 22(6): 1399–1417.

Beck, T. E., & Plowman, D. A. 2014. Temporary, emergent interorganizational collaboration in unexpected circumstances: A study of the Columbia space shuttle response effort. ***Organization Science***, 25(4): 1234–1252.

Berends, H., Van Burg, E., & Van Raaij, E. M. 2011. Contacts and contracts: Cross-level network dynamics in the development of an aircraft material. ***Organization Science***, 22(4): 940–960.

Benson, J. K. 1977. Organizations: A dialectical view. ***Administrative Science Quarterly***, 22(1): 1–21.

Bosch-Sijtsema, P., & Bosch, J. 2015. User involvement throughout the innovation process in high-tech industries. ***Journal of Product Innovation Management***, 32(5): 793–807.

Brusoni, S., & Prencipe, A. 2006. Making design rules: A multidomain perspective. ***Organization Science***, 17(2): 179–189.

Callon, M. 1984. Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St Brieuc Bay. ***The Sociological Review***, 32: 196–233.

Carlile, P. R. 2002. A pragmatic view of knowledge and boundaries: Boundary objects in new product development. ***Organization Science***, 13(4): 442–455.

Carlile, P. R. 2004. Transferring, translating, and transforming: An integrative framework for managing knowledge across boundaries. ***Organization Science***, 15(5): 555–568.

Chesbrough, H. W. 2003. ***Open innovation: The new imperative for creating and profiting from technology***. Boston, MA: Harvard Business School Press.

Constantinides, P., & Barrett, M. 2015. Information infrastructure development and governance as collective action. ***Information Systems Research***, 26(1): 40–56.

Constantinides, P., Henfridsson, O., & Parker, G. G. 2018. Introduction—Platforms and infrastructures in the digital age. ***Information Systems Research***, isre.2018.0794.

Dahlander, L., & Gann, D. M. 2010. How open is innovation? ***Research Policy***, 39(6): 699–709.

Das, T. K., & Teng, B.-S. 2000. Instabilities of strategic alliances: An internal tensions perspective. ***Organization Science***, 11(1): 77–101.

Denis, J. L., Dompierre, G., & Langley, A. 2011. Escalating indecision: Between reification and strategic ambiguity. ***Organization Science***, 22(1): 225–244.

De Rond, M., & Bouchikhi, H. 2004. On the dialectics of strategic alliances. ***Organization Science***, 15(1): 56–69.

De Rond, M., & Lok, J. 2016. Some things can never be unseen: The role of context in psychological injury at war. ***Academy of Management Journal***, 59(6): 1965–1993.

Dittrich, K., & Duysters, G. 2007. Networking as a means to strategy change: The case of open innovation in mobile telephony. ***Journal of Product Innovation Management***, 24(6): 510–521.

Dobusch, L., & Schoeneborn, D. 2015. Fluidity, identity, and organizationality: The communicative constitution of anonymous. ***Journal of Management Studies***, 52(8): 1005–1035.
Dodgson, M., Gann, D., & Salter, A. 2006. The role of technology in the shift towards open innovation: The case of Procter & Gamble. ***R&D Management***, 36(3): 333–346.
Dragsdahl Lauritzen, G., & Karafyllia, M. 2018. Perspective: Leveraging open innovation through paradox. ***Journal of Product Innovation Management***, jpim.12474.
Faems, D., De Visser, M., Andries, P., & Van Looy, B. 2010. Technology alliance portfolios and financial performance: Value-enhancing and cost-increasing effects of open innovation. ***Journal of Product Innovation Management***, 27: 785–796.
Farjoun, M. 2010. Beyond dualism: Stability and change as a duality. ***Academy of Management Review***, 35(2): 202–225.
Farjoun, M. 2016. ***Contradictions, dialectics, and paradoxes***. In A. Langley and H. Tsoukas (eds.), The Sage Handbook of Process Organization Studies: 87–109. London, UK: Sage.
Fjeldstad, Ø. D., Snow, C. C., Miles, R. E., & Lettl, C. 2012. The architecture of collaboration. ***Strategic Management Journal***, 33(6): 734–750.
Garud, R. 2008. Conferences as venues for the configuration of emerging organizational fields: The case of cochlear implants. ***Journal of Management Studies***, 45(6): 1061–1088.
Garud, R., Jain, S., & Kumaraswamy, A. 2002. Institutional entrepreneurship in the sponsorship of common technological standards: The case of Sun Microsystems and Java. ***Academy of Management Journal***, 45(1): 196–214.
George, G., Howard-Grenville, J., Joshi, A., & Tihanyi, L. 2016. Understanding and tackling societal grand challenges through management research. ***Academy of Management Journal***, 59(6): 1880–1895.
Ghazawneh, A., & Henfridsson, O. 2013. Balancing platform control and external contribution in third-party development: The boundary resources model. ***Information Systems Journal***, 23(2): 173–192.
Gray, B., & Hay, T. M. 1986. Political limits to interorganizational consensus and change. ***The Journal of Applied Behavioral Science***, 22(2): 95–112.
Grodal, S., & O'Mahony, S. 2017. How does a grand challenge become displaced? Explaining the duality of field mobilization. ***Academy of Management Journal***, 60(5): 1801–1827.
Gulati, R., Puranam, P., & Tushman, M. 2012a. Meta-organization design: Rethinking design in interorganizational and community contexts. ***Strategic Management Journal***, 33(6): 571–586.
Gulati, R., Wohlgezogen, F., & Zhelyazkov, P. 2012b. The two facets of collaboration: Cooperation and coordination in strategic alliances. ***The Academy of Management Annals***, 6(1): 531–583.
Hardy, C., & Phillips, N. 1998. Strategies of engagement: Lessons from the critical examination of collaboration and conflict in an interorganizational domain. ***Organization Science***, 9(2): 217–230.
Hargrave, T. J., & Van de Ven, A. H. 2017. Integrating dialectical and paradox perspectives on managing contradictions in organizations. ***Organization Studies***, 38(3-4): 319–339.
Harmer, G. P., & Abbott, D. 1999. Losing strategies can win by Parrondo's paradox. ***Nature***, 402(6764): 864.
Henderson, R. M., & Clark, K. B. 1990. Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. ***Administrative Science Quarterly***, 35(1): 9–30.
Henfridsson, O., Nandhakumar, J., Scarbrough, H., & Panourgias, N. 2018. Recombination in the open-ended value landscape of digital innovation. ***Information and Organization***, 28(2): 89–100.
Kallinikos, J., Aaltonen, A., & Marton, A. 2013. The ambivalent ontology of digital artifacts. ***MIS Quarterly***, 37(2): 357–370.
Langley, A. 1999. Strategies for theorizing from process data. ***Academy of Management Review***, 24(4): 691–710.
Langlois, R. N., & Robertson, P. L. 1992. Networks and innovation in a modular system: Lessons from the microcomputer and stereo component industries. ***Research Policy***, 21(4): 297–313.
Laursen, K., & Salter, A. 2004. Searching high and low: What types of firms use universities as a source of innovation? ***Research Policy***, 33(8): 1201–1215.
Laursen, K., & Salter, A. 2006. Open for innovation: the role of openness in explaining innovation performance among U.K. manufacturing firms. ***Strategic Management Journal***, 27(2): 131–150.
Lewis, M. W. 2000. Exploring paradox: Toward a more comprehensive guide. ***Academy of Management Review***, 25(4): 760–776.
Love, J. H., Roper, S., & Vahter, P. 2013. Learning from openness: The dynamics of breadth in external innovation linkages. ***Strategic Management Journal***, 35(11): 1703–1716.
Lumineau, F., & Oliveira, N. 2018. A pluralistic perspective to overcome major blind spots in research on interorganizational relationships. ***The Academy of Management Annals***, 12(1): 440–465.
Majchrzak, A., Griffith, T. L., Reetz, D. K., & Alexy, O. 2018. Catalyst organizations as a new organization design for innovation: The case of hyperloop transportation technologies. ***Academy of Management Discoveries***, 4(4): 472–496.
Majchrzak, A., Jarvenpaa, S. L., & Bagherzadeh, M. 2015. A review of interorganizational collaboration dynamics. ***Journal of Management***, 41(5): 1338–1360.
O'Mahony, S., & Bechky, B. A. 2008. Boundary organizations: Enabling collaboration among unexpected allies. ***Administrative Science Quarterly***, 53(3): 422–459.
O'Reilly, C. A., & Tushman, M. L. 2013. Organizational ambidexterity: Past, present, and future. ***Academy of Management Perspectives***, 27(4): 324–338.
Oxley, J. E., & Sampson, R. C. 2004. The scope and governance of international R&D alliances. ***Strategic Management Journal***, 25(8-9): 723–749.
Poole, M. S., & Van de Ven, A. H. 1989. Using paradox to build management and organization theories. ***Academy of Management Review***, 14(4): 562–578.
Putnam, L. L., Fairhurst, G. T., & Banghart, S. 2016. Contradictions, dialectics, and paradoxes in organizations: A constitutive approach. ***The Academy of Management Annals***, 10(1): 65–171.
Ranganathan, R., Ghosh, A., & Rosenkopf, L. 2018. Competition-cooperation interplay during multifirm technology coordination: The effect of firm heterogeneity on conflict and consensus in a technology standards organization. ***Strategic Management Journal***, 39(12): 3193–3221.

Rosenkopf, L., Metiu, A., & George, V. P. 2001. From the bottom up? Technical committee activity and alliance formation. ***Administrative Science Quarterly***, 46(4): 748–772.
Sanchez, R., & Mahoney, J. T. 1996. Modularity, flexibility, and knowledge management in product and organization design. ***Strategic Management Journal***, 17: 63–67.
Smith, W. K., & Lewis, M. W. 2011. Toward a theory of paradox: A dynamic equilibrium model of organizing. ***Academy of Management Review***, 36(2): 381–403.
Sydow, J., & Windeler, A. 1998. Organizing and evaluating interfirm networks: A structurationist perspective on network processes and effectiveness. ***Organization Science***, 9(3): 265–284.
Tilson, D., Lyytinen, K., & Sørensen, C. 2010. Research commentary–Digital infrastructures: The missing IS research agenda. ***Information Systems Research***, 21(4): 748–759.
Tuertscher, P., Garud, R., & Kumaraswamy, A. 2014. Justification and interlaced knowledge at ATLAS, CERN. ***Organization Science***, 25(6): 1579–1608.
Van Burg, E., Berends, H., & Van Raaij, E. M. 2014. Framing and interorganizational knowledge transfer: A process study of collaborative innovation in the aircraft industry. ***Journal of Management Studies***, 51(3): 349–378.
Van Den Ende, J., Frederiksen, L., & Prencipe, A. 2014. The front end of innovation: Organizing search for ideas. ***Journal of Product Innovation Management***, 32(4): 482–487.
Wareham, J., Fox, P. B., & Cano Giner, J. L. 2014. Technology ecosystem governance. ***Organization Science***, 25(4): 1195–1215.
Yoo, Y., Henfridsson, O., & Lyytinen, K. 2010. Research commentary—The new organizing logic of digital innovation: An agenda for information systems research. ***Information Systems Research***, 21(4): 724–735.
Zeitz, G. 1980. Interorganizational dialectics. ***Administrative Science Quarterly***, 25(1): 72–88.
Zobel, A.-K., Balsmeier, B., & Chesbrough, H. 2016. Does patenting help or hinder open innovation? Evidence from new entrants in the solar industry. ***Industrial and Corporate Change***, 25(2): 307–331.